

**INTERPRETATION IC 90.1-2004-14 OF  
ANSI/ASHRAE/IESNA STANDARD 90.1-2004  
Energy Standard for Buildings Except Low-Rise Residential Buildings**

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**Reference:** This request for interpretation refers to the requirements presented in ANSI/ASHRAE/IESNA Standard 90.1-2004, Section 6.4.1.2 and Tables 6.8.1C and 6.8.1H through J, regarding centrifugal chiller efficiencies.

**Background:** A centrifugal chiller has been selected that is within the operating conditions outlined in Table 6.8.1J and within the ranges for temperatures in Section 6.4.1.2.

The Test Procedure noted in Table 6.8.1C is ARI 550/590 and Section 12 (Normative References) of 90.1-2004 references "ARI/550/590-98 with Addenda through July 2002."

Section 5.5 of the ARI 550/590 test procedure is labelled Fouling Factor Allowances. It references equations in Section C6.3 for mandatory temperature adjustments that must be made in the performance test to account for clean tubes unlike those expected once the chiller is operating for a period of time. A small amount of scale (fouling) is desirable as it protects the tubes from corrosion and pitting but also impedes heat transfer. Conversely, underfilm corrosion under the scale is possible when there is too much fouling.

As a result of the adjustments, the chiller will work harder during the test to meet the agreed-upon performance criteria and hence the specified efficiency will be harder to meet. ARI 550/590 certification and periodic challenge through third party testing uses a standard fouling adjustment of  $0.0001 \text{ h}\cdot\text{ft}^2\cdot^\circ\text{F}/\text{Btu}$  for evaporators and  $0.00025 \text{ h}\cdot\text{ft}^2\cdot^\circ\text{F}/\text{Btu}$  for condensers. Customer specifications sometimes call for a higher fouling factor than the standard ARI 550/590 fouling factor used in the certification program. It is the customer's discretion what fouling factors are to be assumed for the selection, as determined by the cleanliness and their treatment plans for the water and/or the tubes.

**Interpretation:** The interpretation is that, where a customer specification deviates from the standard fouling factors of the certification program, the centrifugal chiller is still required to meet the efficiency levels, both full load and part load, per the appropriate table (6.8.1C, H, I or J). A chiller should not be allowed to use more energy simply because the application the user is not intending to adequately maintain the chilled water system to a normal amount of fouling. A centrifugal chiller with a lower fouling factor specified (and thus appearing to be more efficient than it would be at standard fouling assumptions) would have to meet or beat the 90.1 levels when adjusted to assume standard fouling factors.

**Question:** Is this interpretation correct?

**Answer:** No

**Comment:** The ASHRAE 90.1 Standard references ARI 550/590. Standard fouling level is defined by ARI 550/590. Since new machines are assumed to have zero fouling, the testing requirements of ARI 550/590 require temperature adjustments to simulate the standard fouling allowance and enable performance validation. This provides a basis for equal comparison of equipment efficiencies. Determination of 90.1 compliance is based on using the identical chiller configuration (impeller, motor, gear, heat exchangers, and starter, etc) when calculating the rating with the ARI 550/590 standard fouling.

The 90.1 committee also agrees that proper maintenance and water treatment is recommended to obtain these standard fouling adjustments; poor maintenance or water treatment resulting in higher fouling limits is strongly discouraged as it results in reduced efficiency of equipment, regardless of unit design efficiency.